

IN THE UNITED STATES DISTRICT COURT
FOR THE DISTRICT OF DELAWARE

| | | |
|-----------------------------------|---|------------------------------|
| THE GILLETTE COMPANY, |) | |
| |) | |
| Plaintiff, |) | C.A. No. 15-1158 (LPS) (CJB) |
| |) | |
| v. |) | DEMAND FOR JURY TRIAL |
| |) | |
| DOLLAR SHAVE CLUB, INC., DORCO |) | |
| COMPANY LTD. and PACE SHAVE, INC. |) | |
| |) | |
| Defendants. |) | |

FIRST AMENDED COMPLAINT FOR PATENT INFRINGEMENT

Plaintiff The Gillette Company (“Gillette” or “Plaintiff”), by and through its attorneys, for its complaint against Defendants Dollar Shave Club, Inc. (“DSC”), Dorco Company, Ltd. (“Dorco”), and Pace Shave, Inc. (“Pace Shave”) (collectively “Defendants”) alleges as follows:

NATURE OF THE ACTION

1. This is an action for patent infringement arising under the patent laws of the United States, 35 U.S.C. §§ 271, *et seq.*, to enjoin infringement and obtain damages resulting from Defendants’ unauthorized manufacture, use, sale, offer to sell and/or importation into the United States for subsequent use or sale of products that infringe one or more claims of U.S. Patent No. 6,684,513 (the “’513 Patent”) (attached as Exhibit A) entitled “Razor Blade Technology.” Plaintiff seeks injunctive relief to prevent Defendants from continuing to infringe Plaintiff’s patent. In addition, Plaintiff seeks a recovery of monetary damages resulting from Defendants’ past infringement of this patent.

2. This action for patent infringement involves Defendants manufacture, use, sale, offer for sale, and/or importation into the United States of infringing razor products

marketed and sold under the names “The Humble Twin,” “The 4X” and “The Executive” and cartridges thereto (“DSC’s Accused Products”), and the “Pace 6 Plus” razor (SXA 5000), “Pace 6 Plus” cartridges (SXA 5040), the “Pace 6” razor (SXA 1000), “Pace 6” cartridges (SXA 1040), the “Pace 4” razor (FRA 1000), “Pace 4” cartridges (FRA 1040), the “Pace 3” razor (TRA 1000), “Pace 3” cartridges (TRA 1040), the “Pace 3 & 4 Try Me” razor (FRA 1005), the “Comfort Thin II” razor (TNA 3006), “Comfort Thin II” cartridges (TNA 3050), the “Pace 6 Disposable” razor (SXA 200 and SXB 100), the “Pace 4 Disposable” razor (FRA 100), the “Pace 3 Disposable” razor (TRB 100, TRA 400, TRA 200 and TRA 100), the “Pace Twin Blade Disposable” razor (TG 1101M, TG 710M, TG 711M and TG 708), “Pace Twin Blade” cartridges (TGP 100), the “Shai 6 Smooth Touch” razor (SXA 2000), “Shai 6 Smooth Touch” cartridges (SXA 2040), the “Shai 6” razor (SXA 3000), “Shai 6” cartridges (SXA 3040), the “Shai 4” razor, (FRA 2000), “Shai 4” cartridges (FRA 2040), the “Shai 3” razor (TRA 2000), “Shai 3” cartridges (TRA 2040), the “Shai 3 & 4 Try Me” razor (FRA 2002), the “Shai 6 Disposable” razor (SXA 400), the “Pace 6 Disposable” razor (SXA 300), the “Shai 4 Disposable” razor (FRA 200), the “Shai 3 Disposable” razor (TRA 100, TRA 200, TRA 400 and TRA 500), the “Lady Pace Twin Blade Disposable” razor (TG1101), the “Pace Twin Blade Disposable” razor (TG 710 and TG 711), the “Torq” razor, the “Swipe” razor, and private label brands of any of the above razors or cartridges (the DSC Accused Products and all of the other products listed above are collectively referred to herein as “the Accused Products”).

THE PARTIES

Plaintiff

3. Plaintiff Gillette is a corporation organized and existing under the laws of the State of Delaware, and has offices located at 1 Gillette Park, Boston, Massachusetts.

Defendants

4. Defendant DSC is a corporation organized and existing under the laws of the State of Delaware with its principal place of business at 513 Boccacio Avenue, Venice, California 90291.

5. Defendant Dorco is a corporation organized and existing under the laws of South Korea, with its principal place of business at 1435-15, Seocho-dong, Seocho-gu, Seoul, Korea.

6. Defendant Pace Shave is a corporation organized and existing under the laws of the State of California, and has offices located at 9370 Sky Park Court, Suite 100, San Diego California.

JURISDICTION AND VENUE

7. This Court has jurisdiction over the subject matter of this patent infringement action pursuant to 28 U.S.C. §§ 1331 and 1338(a).

DSC

8. Defendant DSC is subject to personal jurisdiction in this judicial district because it is incorporated in Delaware and because it regularly transacts business in this judicial district by, among other things, selling and offering for sale its razor products, including DSC's Accused Products, to customers located in this judicial district. DSC has committed acts of infringement of one or more claims of the patent-in-suit in this judicial district.

9. Venue is proper in this judicial district pursuant to 28 U.S.C. §§ 1391(b), (c) and 1400(b) because Defendant DSC is subject to personal jurisdiction in this district, conducts business in this district and has committed acts of patent infringement in this district.

Dorco

10. Defendant Dorco is subject to personal jurisdiction in this judicial district because Dorco itself, and through its subsidiaries, has engaged in continuous and systematic contacts with Delaware and/or purposefully availed itself of this forum by, amongst other things, marketing, importing, making, shipping, using, offering to sell or selling, or causing others to use, offer to sell, or sell the Accused Products, in Delaware, and deriving substantial revenue from such activities. For example, Dorco continually distributes and/or has distributed the Accused Products through established distribution channels in Delaware, including, but not limited to, upon information and belief, Dollar Shave Club, Costco, Sam's Club, K-Mart, Bed Bath & Beyond, Walgreens, Family Dollar, Dollar General, Dorco USA, Inc., Pace Shave, Inc., and CVS, and has knowledge that its infringing products are sold and/or have been sold through these channels. Upon information and belief, Dorco has not made efforts to exclude Delaware from its distribution networks. Upon information and belief, Dorco has committed, or aided, abetted, contributed to, induced, and or participated in the tortious action of patent infringement that has led to foreseeable harm and injury to Gillette.

11. Venue is proper in this judicial district pursuant to 28 U.S.C. §§ 1391(b), (c) and 1400(b) because Defendant Dorco is subject to personal jurisdiction in this district.

Pace Shave

12. Defendant Pace Shave is subject to personal jurisdiction in this judicial district because Pace Shave has engaged in continuous and systematic contacts with Delaware and/or purposefully availed itself of this forum by, amongst other things, marketing, importing, making, shipping, using, offering to sell or selling, or causing others to use, offer to sell, or sell the Accused Products, in Delaware, and deriving substantial revenue from such activities. For

example, Pace Shave continually distributes and/or has distributed the Accused Products through established distribution channels in Delaware, including, but not limited to, upon information and belief, Dollar Shave Club, Costco, Sam's Club, K-Mart, Bed Bath & Beyond, Walgreens, Family Dollar, Dollar General, and CVS, and has knowledge that its infringing products are sold or have been sold through these channels. Pace Shave's website identifies Harmon, Bed Bath & Beyond, Walgreens, K-Mart, Dollar General, and Family Dollar as retail partners; products that are sold and/or have been sold through these retailers; and links to locate these stores, including those in Delaware. Upon information and belief, Pace Shave has not made efforts to exclude Delaware from its distribution network. Upon information and belief, Pace Shave has committed, or aided, abetted, contributed to, induced, and or participated in the tortious action of patent infringement that has led to foreseeable harm and injury to Gillette.

13. Venue is proper in this judicial district pursuant to 28 U.S.C. §§ 1391(b), (c) and 1400(b) because Defendant Pace Shave is subject to personal jurisdiction in this district.

FACTUAL BACKGROUND

Gillette

14. Since 1895, Gillette has been a leading innovator in the shaving industry. Gillette's innovations have included the first safety razor, which was distributed to U.S. soldiers during World War I, the first women's razor, the first razor dispenser, the first razor with stainless steel blades, the first double-bladed razor, the first razor with a lubricating strip, and the first razor with three progressively-aligned blades.

15. Over the course of more than 100 years in the marketplace, Gillette razors and razor products have become associated with high quality, safety, comfort and performance.

Today, Gillette razors are sold in all 50 states and in more than 200 countries. Gillette razors are used by more than 750 million people worldwide.

16. Reflecting on Gillette's many innovations in shaving technology, Gillette holds hundreds of patents relating to razors and razor technology. Gillette has been diligent in protecting and enforcing its intellectual property through the years.

DSC

17. On information and belief, Defendant DSC began operations on or about July 2011, and launched its membership service on or about March, 2012.

18. DSC promotes, offers for sale, and sells its razors and related shaving products online through an Internet web site accessible at www.dollarshaveclub.com.

19. DSC's ads tout that by joining its membership club, members can get razors delivered to their doorsteps every month for significantly less cost than "brand name" products.

20. On information and belief, since its membership launch, DSC has acquired over 2 million subscribers. Its ads tout that it ships over 44 million razor cartridges and now has a 10% share of the U.S. market for men's razor cartridges.

Dorco

21. Dorco makes, imports, distributes, markets advertises and sells and has sold its razors and razor products to national retailers in the United States, including but not limited to, CVS/Pharmacy, a national retail chain with over 4,000 stores in the United States, K-Mart Inc., a national retail chain with over 1,400 stores in the United States, Costco, Sam's Club, Bed Bath & Beyond, Walgreens, Pace Shave, Family Dollar, Dollar General, and Dollar Shave Club.

22. Dorco's Korean website, specifically identifies Sam's Club, K-Mart, and Dollar General as North American retailers for its products.

23. Among these products are Dorco's two, three, four and six bladed razors including the Accused Products.

Pace Shave

24. Pace Shave imports, distributes, markets, advertises and sells and has sold Dorco razors and razor products to national retailers, including but not limited to, CVS/Pharmacy, a national retail chain with over 4,000 stores in the United States, K-Mart Inc., a national retail chain with over 1,400 stores in the United States, Costco, Sam's Club, Family Dollar, Dollar General, and DollarShave Club.

25. Among these products are Dorco's two, three, four and six bladed razors including the Accused Products.

The '513 Patent

26. On February 3, 2004, United States Patent No. 6,684,513 was duly and legally issued for an invention entitled "Razor Blade Technology."

27. The '513 Patent is directed to a razor blade including a substrate with a cutting edge defined by a sharpened tip and adjacent facets, a layer of hard coating on the cutting edge being made of amorphous material containing carbon, an overcoat layer of a chromium containing material on the layer of hard coating, and an outer layer of polytetrafluoroethylene coating over the overcoat layer.

28. The invention of the '513 Patent is advantageous because the use of a chromium containing overcoat layer provides improved adhesion of the polytetrafluoroethylene outer layer. The razor blade has improved edge strength provided by the hard coating and has

reduced tip rounding with repeated shaves. Reduced tip rounding minimizes any increase in cutting force thereby maintaining excellent shaving performance. The invention provides the razor blade with excellent shaving characteristics from the first shave onwards, and promotes durability.

29. Gillette owns all right, title and interest in and to the '513 Patent and possesses all rights of recovery.

30. Gillette's Mach3[®], Venus[®] and Fusion[®] razor products, among others, practice one or more claims of the '513 Patent.

31. Gillette provides virtual marking on its website identifying its products that practice the '513 Patent and thereby provides constructive notice to the world of its patent rights.

32. DSC has made, used, sold, and/or offered for sale within the United States, and/or imported into the United States, razors including, but not limited to, the Accused Products that infringe at least claims 1, 2, 6, 8, 15-17, 19-20, 23, 24, 28-29, and 31-38 of the '513 Patent.

33. On information and belief, DSC has had knowledge of the '513 Patent since at least the filing of the original complaint on December 17, 2015, and that DSC's Accused Products infringe the claims of the '513 Patent.

34. DSC has been inducing and/or contributing to its customers' direct infringement of the '513 Patent claims by selling, offering for sale, promoting, marketing and/or importing into the United States DSC's Accused Products for subsequent infringing use by its customers.

35. Dorco has made, used, sold, and/or offered for sale within the United States, and/or imported into the United States, razors including, but not limited to, the Accused

Products that infringe at least claims 1, 2, 6, 8, 15-17, 19-20, 23, 24, 28-29, and 31-38 of the '513 Patent.

36. On information and belief, Dorco has had knowledge of the '513 Patent since at least the filing of the original complaint on December 17, 2015, and that the Accused Products infringe the claims of the '513 Patent.

37. Dorco has been inducing and/or contributing to its customers' direct infringement of the '513 Patent claims by making, selling, offering for sale, marketing and/or importing into the United States the Accused Products for subsequent use, sale and offering for sale by its customers.

38. Pace Shave has made, used, sold, and/or offered for sale within the United States, and/or imported into the United States, razors including, but not limited to, the Accused Products that infringe at least claims 1, 2, 6, 8, 15-17, 19-20, 23, 24, 28-29, and 31-38 of the '513 Patent.

39. On information and belief, Pace Shave has had knowledge of the '513 Patent since at least the filing of the original complaint on December 17, 2015, and that the Accused Products infringe the claims of the '513 Patent.

40. Pace Shave has been inducing and/or contributing to its customers' direct infringement of the '513 Patent claims by making, selling, offering for sale, marketing and/or importing into the United States the Accused Products for subsequent use, sale and offering for sale by its customers.

41. Gillette is being irreparably harmed by Defendants' infringement of its valuable patent rights. Moreover, Defendants' unauthorized infringement of Gillette's patent rights is threatening the value of this intellectual property because Defendants' conduct results in

Gillette's loss of its lawful patent rights to exclude others from making, using, selling, offering to sell and/or importing the patented inventions.

COUNT I
DSC'S INFRINGEMENT OF U.S. PATENT NO. 6,684,513

42. Paragraphs 1- 41 are incorporated by reference as if fully restated herein.

43. DSC's Accused Products infringe at least claims 1, 2, 6, 8, 15-17, 19-20, 23, 24, 28-29, and 31-38 of the '513 Patent.

44. Each of DSC's Accused Products includes a razor blade that has a substrate having a cutting edge with a sharpened tip and adjacent facets.

45. Each of the substrates has a layer of hard coating on the cutting edge that is made of amorphous material, with the amorphous material containing carbon.

46. Each of the substrates has an overcoat layer on top of the layer of hard coating, with the overcoat layer having chromium.

47. Each of the substrates contains an outer layer of polytetrafluoroethylene over the overcoat layer.

48. DSC's Accused Products and the razor blades in DSC's Accused Products have no use other than infringing one of more claims of the '513 patent.

49. DSC's conduct has constituted and will constitute direct infringement of one or more claims of the '513 patent under 35 U.S.C. § 271(a) & (g), inducement of infringement of the '513 patent under 35 U.S.C. § 271(b), and contributory infringement under 35 U.S.C. § 271(c).

50. DSC's acts of direct infringement, induced infringement and contributory infringement have caused damage to Gillette, and Gillette is entitled to recover from DSC the damages sustained by Gillette as a result of DSC's wrongful acts in an amount subject to proof

at trial. DSC's infringement of Gillette's exclusive rights under the '513 Patent will continue to damage Gillette's business, causing irreparable harm for which there is no adequate remedy at law, unless DSC is enjoined by this Court.

COUNT II
DORCO'S INFRINGEMENT OF U.S. PATENT NO. 6,684,513

51. Paragraphs 1-50 are incorporated by reference as if fully restated herein.

52. The Accused Products infringe at least claims 1, 2, 6, 8, 15-17, 19-20, 23, 24, 28-29 and 31-38 of the '513 Patent.

53. Each of the Accused Products includes a razor blade that has a substrate having a cutting edge with a sharpened tip and adjacent facets.

54. Each of the substrates has a layer of hard coating on the cutting edge that is made of amorphous material, with the amorphous material containing carbon.

55. Each of the substrates has an overcoat layer on top of the layer of hard coating, with the overcoat layer having chromium.

56. Each of the substrates contains an outer layer of polytetrafluoroethylene over the overcoat layer.

57. The Accused Products and the razor blades in the Accused Products have no use other than infringing one or more claims of the '513 patent.

58. Dorco's conduct has constituted and will constitute direct infringement of one or more claims of the '513 patent under 35 U.S.C. § 271(a) & (g), inducement of infringement of the '513 patent under 35 U.S.C. § 271(b), and contributory infringement under 35 U.S.C. § 271(c).

59. Dorco's acts of direct infringement, induced infringement, and contributory infringement have caused damage to Gillette, and Gillette is entitled to recover from

Dorco the damages sustained by Gillette as a result of Dorco's wrongful acts in an amount subject to proof at trial. Dorco's infringement of Gillette's exclusive rights under the '513 Patent will continue to damage Gillette's business, causing irreparable harm for which there is no adequate remedy at law, unless Dorco is enjoined by this Court.

COUNT III
PACE SHAVE'S INFRINGEMENT OF U.S. PATENT NO. 6,684,513

60. Paragraphs 1-59 are incorporated by reference as if fully restated herein.

61. The Accused Products infringe at least claims 1, 2, 6, 8, 15-17, 19-20, 23, 24, 28-29 and 31-38 of the '513 Patent.

62. Each of the Accused Products includes a razor blade that has a substrate having a cutting edge with a sharpened tip and adjacent facets.

63. Each of the substrates has a layer of hard coating on the cutting edge that is made of amorphous material, with the amorphous material containing carbon.

64. Each of the substrates has an overcoat layer on top of the layer of hard coating, with the overcoat layer having chromium.

65. Each of the substrates contains an outer layer of polytetrafluoroethylene over the overcoat layer.

66. The Accused Products and the razor blades in the Accused Products have no use other than infringing one or more claims of the '513 patent.

67. Pace Shave's conduct has constituted and will constitute direct infringement of one or more claims of the '513 patent under 35 U.S.C. § 271(a) & (g), inducement of infringement of the '513 patent under 35 U.S.C. § 271(b), and contributory infringement under 35 U.S.C. § 271(c).

68. Pace Shave's acts of direct infringement, induced infringement, and contributory infringement have caused damage to Gillette, and Gillette is entitled to recover from Pace Shave the damages sustained by Gillette as a result of Pace Shave's wrongful acts in an amount subject to proof at trial. Pace Shave's infringement of Gillette's exclusive rights under the '513 Patent will continue to damage Gillette's business, causing irreparable harm for which there is no adequate remedy at law, unless Pace Shave is enjoined by this Court.

PRAYER FOR RELIEF

WHEREFORE, Gillette prays for judgment as follows:

A. That this Court adjudge and decree that Defendants have directly and/or indirectly infringed the '513 Patent;

B. That this Court permanently enjoin the Defendants and their subsidiaries, affiliates, successors and assigns and each of their officers, directors, agents, servants, employees, licensees, and all persons acting in concert or active participation with them, or on their behalf, or within their control, from engaging in any acts that constitute infringement of the '513 Patent;

C. That this Court order an accounting, including a post-verdict accounting, to determine the damages to be awarded to Gillette as a result of Defendants' infringement;

D. That this Court, pursuant to 35 U.S.C. § 284, enter an award to Gillette of such damages as it shall prove at trial against Defendants that are adequate to compensate Gillette for said infringement, such damages to be no less than a reasonable royalty together with interest and costs;

E. That this Court assess pre-judgment and post-judgment interest and costs, together with an award of such interest and costs, in accordance with 35 U.S.C. § 284; and

F. That Gillette be awarded such further relief as this Court may deem just and appropriate.

DEMAND FOR JURY TRIAL

Gillette demands a trial by jury of all matters to which it is entitled to a trial by jury pursuant to Federal Rule of Civil Procedure 38.

MORRIS, NICHOLS, ARSHT & TUNNELL LLP

/s/ Rodger D. Smith II

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EXHIBIT A

US006684513B1

(12) **United States Patent**
Clipstone et al.(10) **Patent No.:** **US 6,684,513 B1**
(45) **Date of Patent:** **Feb. 3, 2004**(54) **RAZOR BLADE TECHNOLOGY**(75) Inventors: **Colin John Clipstone**, Weston, MA (US); **Steve Hahn**, Wellesley, MA (US); **Neville Sonnenberg**, Newton, MA (US); **Charles White**, Lynnfield, MA (US); **Andrew Zhuk**, Acton, MA (US)(73) Assignee: **The Gillette Company**, Boston, MA (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

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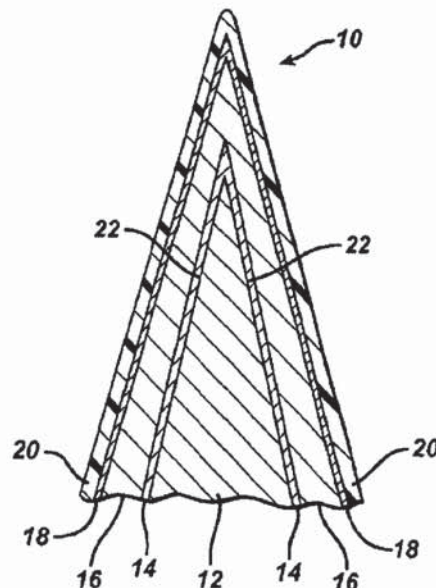
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Primary Examiner—Hwei-Siu Payer(74) *Attorney, Agent, or Firm*—Fish & Richardson P.C.(57) **ABSTRACT**

A razor blade including a substrate with a cutting edge defined by a sharpened tip and adjacent facets, a layer of hard coating on the cutting edge, an overcoat layer of a chromium containing material on the layer of hard carbon coating, and an outer layer of polytetrafluoroethylene coating over the overcoat layer.

38 Claims, 1 Drawing Sheet(56) **References Cited****U.S. PATENT DOCUMENTS**

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U.S. Patent

Feb. 3, 2004

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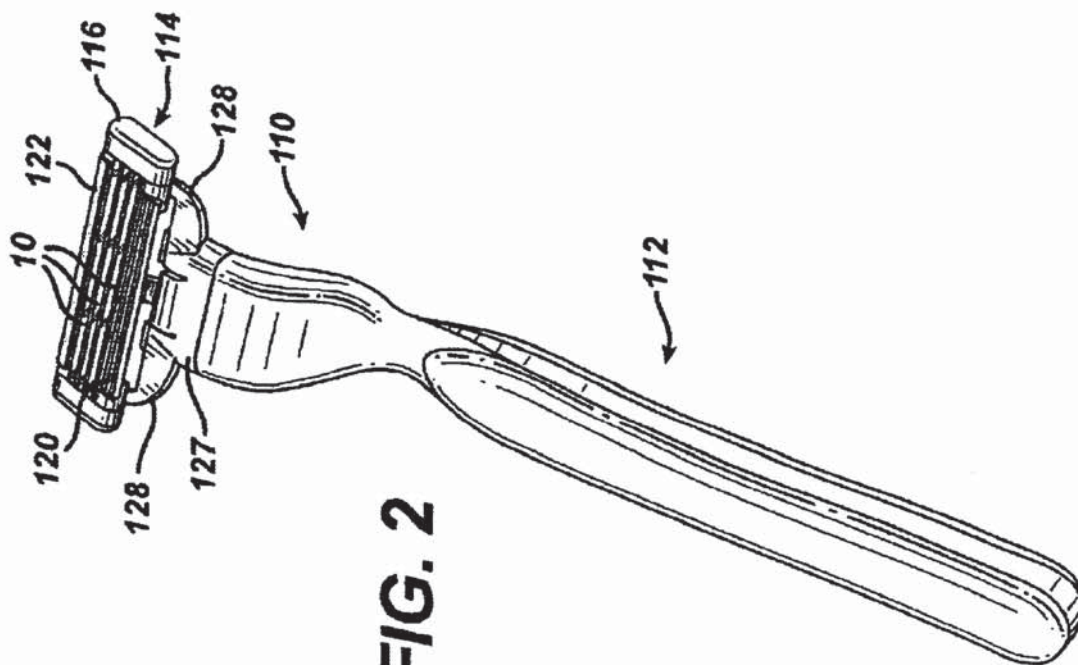
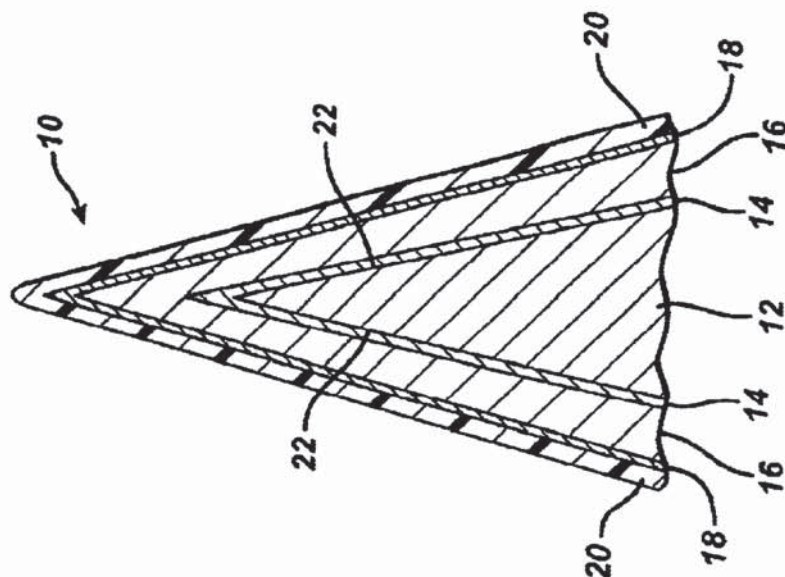


FIG. 1



US 6,684,513 B1

1

RAZOR BLADE TECHNOLOGY

The invention relates to improvements to razors and razor blades.

A razor blade is typically formed of a suitable substrate material such as stainless steel, and a cutting edge is formed with a wedge-shaped configuration with an ultimate tip having a radius less than about 1000 angstroms, e.g., about 200–300 angstroms. Hard coatings such as diamond, amorphous diamond, diamond-like carbon-(DLC) material, nitrides, carbides, oxides or ceramics are often used to improve strength, corrosion resistance and shaving ability, maintaining needed strength while permitting thinner edges with lower cutting forces to be used. Polytetrafluoroethylene (PTFE) outer layer can be used to provide friction reduction. Interlayers of niobium or chromium containing materials can aid in improving the binding between the substrate, typically stainless steel, and hard carbon coatings, such as DLC. Examples of razor blade cutting edge structures and processes of manufacture are described in U.S. Pat. Nos. 5,295,305; 5,232,568; 4,933,058; 5,032,243; 5,497,550; 5,940,975; 5,669,144; EP 0591339; and PCT 92/03330, which are hereby incorporated by reference.

In use, the ultimate tip of the edges having hard coatings and polytetrafluoroethylene outer layers can become more rounded after repeated shaves such that there is an increase in the tip radius and a generally perceived decrease in shaving performance.

SUMMARY OF THE INVENTION

In one aspect, the invention features, in general, a razor blade including a substrate with a cutting edge defined by a sharpened tip and adjacent facets, a layer of hard coating on the cutting edge, an overcoat layer of a chromium containing material on the layer of hard coating, and an outer layer of polytetrafluoroethylene coating on the overcoat layer.

In another aspect the invention features, in general, a shaving razor including a handle and a razor head with a blade having a substrate with a cutting edge defined by a sharpened tip and adjacent facets, a layer of hard coating on the cutting edge, an overcoat layer of a chromium containing material on the layer of hard coating, and an outer layer of polytetrafluoroethylene coating on the overcoat layer.

Particular embodiments of the invention may include one or more of the following features. In particular embodiments, the hard coating material can be made of carbon containing materials (e.g., diamond, amorphous diamond or DLC), nitrides, carbides, oxides or other ceramics. The hard coating layer can have a thickness less than 2,000 angstroms. The overcoat layer can be made of chromium or a chromium containing alloy compatible with polytetrafluoroethylene such as a chromium platinum alloy. The overcoat layer can be between 100 and 500 angstroms thick. The blade can include an interlayer between the substrate and the layer of hard coating. The interlayer can include niobium or a chromium containing material. The polytetrafluoroethylene can be Krytox LW1200 available from DuPont. The PTFE outer layer can be between 100 and 5000 angstroms thick.

In another aspect, the invention features, in general, making a razor blade by providing a substrate with a cutting edge defined by a sharpened tip and adjacent facets, adding a layer of hard coating on the cutting edge, adding an overcoat layer of a chromium containing material on the layer of hard coating, and adding an outer layer of polytetrafluoroethylene coating over the overcoat layer.

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Particular embodiments of the invention may include one or more of the following features. In particular embodiments the layers can be added by physical vapor deposition (i.e., sputtering) or by chemical vapor deposition. The chromium containing layer, preferably chromium, can be sputter deposited under conditions that result in a compressively stressed coating. The sputter deposition of chromium containing materials can include applying a DC bias to the target that is more negative than –50 volts, preferably more negative than –200 volts. Alternatively an appropriate RF bias scheme can be used to achieve an equivalent chromium layer.

Embodiments of the invention may include one or more of the following advantages. The use of a chromium containing overcoat layer provides improved adhesion of the polytetrafluoroethylene outer layer to the hard coating layer. The razor blade has improved edge strength provided by hard coating and has reduced tip rounding with repeated shaves. Reduced tip rounding minimizes the increase in cutting force thereby maintaining excellent shaving performance. The razor blade has excellent shaving characteristics from the first shave onwards.

Other features and advantages of the invention will be apparent from the following description of a particular embodiment and from the claims.

DESCRIPTION OF THE DRAWINGS

FIG. 1 is a vertical sectional view of a cutting edge portion of a razor blade.

FIG. 2 is a perspective view of a shaving razor including the FIG. 1 razor blade.

DESCRIPTION OF A PARTICULAR EMBODIMENT

Referring to FIG. 1, there is shown razor blade including substrate 12, interlayer 14, hard coating layer 16, overcoat layer 18, and outer layer 20. The substrate 12 is typically made of stainless steel (though other substrates can be employed) and has an ultimate edge sharpened to a tip radius of less than 1,000 angstroms, preferably 200 to 300 angstroms, and has a profile with side facets 22 at an included angle of between 15 and 30 degrees, preferably about 19 degrees, measured at 40 microns from the tip.

Interlayer 14 is used to facilitate bonding of the hard coating layer to the substrate. Examples of suitable interlayer material are niobium and chromium containing material. A particular interlayer is made of niobium greater than 100 angstroms and preferably less than 500 angstroms thick. PCT 92/03330 describes use of a niobium interlayer.

Hard coating layer 16 provides improved strength, corrosion resistance and shaving ability and can be made from carbon containing materials (e.g., diamond, amorphous diamond or DLC), nitrides (e.g., boron nitride, niobium nitride or titanium nitride), carbides (e.g., silicon carbide), oxides (e.g., alumina, zirconia) or other ceramic materials. The carbon containing materials can be doped with other elements, such as tungsten, titanium or chromium by including these additives, for example in the target during application by sputtering. The materials can also incorporate hydrogen, e.g., hydrogenated DLC. Preferably coating layer 16 is made of diamond, amorphous diamond or DLC. A particular embodiment includes DLC less than 2,000 angstroms, preferably less than 1,000 angstroms. DLC layers and methods of deposition are described in U.S. Pat. No. 5,232,568. As described in the “Handbook of Physical Vapor

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Deposition (PVD) Processing," DLC is an amorphous carbon material that exhibits many of the desirable properties of diamond but does not have the crystalline structure of diamond.

Overcoat layer 18 is used to reduce the tip rounding of the hard coated edge and to facilitate bonding of the outer layer to the hard coating while still maintaining the benefits of both. Overcoat layer 18 is preferably made of chromium containing material, e.g., chromium or chromium alloys that are compatible with polytetrafluoroethylene, e.g., CrPt. A particular overcoat layer is chromium about 100–200 angstroms thick. Blade 10 has a cutting edge that has less rounding with repeated shaves than it would have without the overcoat layer.

Outer layer 20 is used to provide reduced friction and includes polytetrafluoroethylene and is sometimes referred to as a telomer. A particular polytetrafluoroethylene material is Krytox LW 1200 available from DuPont. This material is a nonflammable and stable dry lubricant that consists of small particles that yield stable dispersions. It is furnished as an aqueous dispersion of 20% solids by weight and can be applied by dipping, spraying, or brushing, and can thereafter be air dried or melt coated. The layer is preferably less than 5,000 angstroms and could typically be 1,500 angstroms to 4,000 angstroms, and can be as thin as 100 angstroms, provided that a continuous coating is maintained. Provided that a continuous coating is achieved, reduced telomer coating thickness can provide improved first shave results. U.S. Pat. Nos. 5,263,256 and 5,985,459, which are hereby incorporated by reference, describe techniques which can be used to reduce the thickness of an applied telomer layer.

Razor blade 10 is made generally according to the processes described in the above referenced patents. A particular embodiment includes a niobium interlayer 14, DLC hard coating layer 16, chromium overcoat layer 18, and Krytox LW1200 polytetrafluoroethylene outer coat layer 20. Chromium overcoat layer 18 is deposited to a minimum of 100 angstroms and a maximum of 500 angstroms. It is deposited by sputtering using a DC bias (more negative than –50 volts and preferably more negative than –200 volts) and pressure of about 2 millitorr argon. The increased negative bias is believed to promote a compressive stress (as opposed to a tensile stress), in the chromium overcoat layer which is believed to promote improved resistance to tip rounding while maintaining good shaving performance. Blade 10 preferably has a tip radius of about 200–400 angstroms, measured by SEM after application of overcoat layer 18 and before adding outer layer 20.

Referring to FIG. 2, blade 10 can be used in shaving razor 110, which includes handle 112 and replaceable shaving cartridge 114. Cartridge 114 includes housing 116, which carries three blades 10, guard 120 and cap 122. Blades 10 are movably mounted, as described, e.g., in U.S. Pat. No. 5,918,369, which is incorporated by reference. Cartridge 114 also includes an interconnect member on which housing 116 is pivotally mounted at two arms 128. The interconnect member includes a base 127 which is replaceably connected to handle 112. Alternatively, blade 10 can be used in other razors having one, two or more than three blades, double-sided blades, and razors that do not have movable blades or pivoting heads where the cartridge is either replaceable or permanently attached to a razor handle.

In use, razor blade 10 has excellent shaving characteristics from the first shave onwards. Blade 10 has improved edge strength provided by hard coating and has reduced tip rounding with repeated shaves provided by the overlayer coating while maintaining excellent shave characteristics.

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Other embodiments of the invention are within the scope of the appended claims.

What is claimed is:

1. A razor blade comprising a substrate with a cutting edge defined by a sharpened tip and adjacent facets,
 - a layer of hard coating on said cutting edge, said hard coating being made of amorphous material containing carbon,
 - an overcoat layer of a chromium containing material on said layer of hard coating, and
 - an outer layer of polytetrafluoroethylene coating over said overcoat layer.
2. The blade of claim 1 wherein said hard carbon coating comprises diamond-like carbon material.
3. The blade of claim 2 wherein said overcoat layer consists of chromium.
4. The blade of claim 3 wherein said polytetrafluoroethylene is Krytox LW1200.
5. The blade of claim 2 further comprising a niobium interlayer between said substrate and said hard coating.
6. The blade of claim 1 wherein said hard carbon coating comprises amorphous diamond material.
7. The blade of claim 1 wherein said overcoat layer consists of chromium.
8. The blade of claim 1 wherein said overcoat layer consists of a chromium containing alloy compatible with polytetrafluoroethylene.
9. The blade of claim 8 wherein said alloy is a chromium platinum alloy.
10. The blade of claim 7, 8, 3, or 9 wherein said overcoat layer is compressively stressed.
11. The blade of claim 1 further comprising an interlayer between said substrate and said layer of hard coating.
12. The blade of claim 11 wherein said interlayer comprises niobium.
13. The blade of claim 11 wherein said interlayer comprises a chromium containing material.
14. The blade of claim 1 wherein said polytetrafluoroethylene is Krytox LW1200.
15. The blade of claim 1 wherein said hard coating layer has a thickness less than 2,000 angstroms.
16. The blade of claim 1 wherein said overcoat layer is between 100 and 500 angstroms thick.
17. The blade of claim 1 wherein said outer layer is between 100 and 5,000 angstroms thick.
18. The blade of claim 1, 3, 4 or 15 wherein said cutting edge has less rounding with repeated shaves than it would have without said overcoat layer.
19. The blade of claim 1 wherein said hard coating is doped with another element.
20. A shaving razor comprising
 - a handle,
 - a housing connected to said handle, and
 - at least one razor blade mounted in said housing, said blade comprising
 - a substrate with a cutting edge defined by a sharpened tip and adjacent facets,
 - a layer of hard coating on said cutting edge, said hard coating being made of amorphous material containing carbon,
 - an overcoat layer of a chromium containing material on said layer of hard coating, and
 - an outer layer of polytetrafluoroethylene coating over said overcoat layer.
21. The razor of claim 20 further comprising a niobium interlayer between said substrate and said hard coating.

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22. The razor of claim 20 wherein said overcoat layer consists of chromium.

23. The razor of claim 20 wherein said hard coating is doped with another element.

24. A method of making a razor blade comprising

providing a substrate with a cutting edge defined by a sharpened tip and adjacent facets,

adding a layer of hard coating on said cutting edge, said hard coating being made of amorphous material containing carbon,

adding an overcoat layer of a chromium containing material on said layer of hard coating, and

adding an outer layer of polytetrafluoroethylene coating over said overcoat layer.

25. The method of claim 24 wherein said adding a layer of hard coating includes vapor depositing a carbon containing material.

26. The method of claim 24 wherein said adding a layer of chromium containing material includes vapor depositing said chromium containing material.

27. The method of claim 26 wherein said adding a layer of chromium containing material includes sputter depositing under conditions to result in compressively stressed material.

28. A razor blade comprising

a substrate with a cutting edge defined by a sharpened tip and adjacent facets;

a layer of a hard carbon containing material, doped with another element, on the cutting edge;

an overcoat layer of a chromium containing material on the layer of the hard carbon containing material; and
an outer layer of polytetrafluoroethylene over the overcoat layer.

29. The razor blade of claim 28, wherein the element is a metal.

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30. The razor blade of claim 29, wherein the metal is selected from the group consisting of tungsten and titanium.

31. The razor blade of claim 29, wherein the metal is chromium.

32. The razor blade of claim 31, wherein the hard carbon containing material is diamond-like carbon.

33. The razor blade of claim 28, wherein the hard carbon containing material is selected from the group consisting of diamond-like carbon and amorphous diamond.

34. The razor blade of claim 28, wherein the layer of hard carbon material has a thickness less than 2,000 angstroms, the overcoat layer has a thickness between 100 and 500 angstroms, and the outer layer has a thickness between 100 and 5,000 angstroms.

35. A shaving razor comprising

a handle,

a housing connected to the handle, and

at least one razor blade within the housing, the razor blade comprising

a substrate with a cutting edge defined by a sharpened tip and adjacent facets;

a layer of a hard carbon containing material, doped with another element, on the cutting edge;

an overcoat layer of a chromium containing material on the layer of the hard carbon containing material; and
an outer layer of polytetrafluoroethylene over the overcoat layer.

36. The shaving razor of claim 35, wherein the element is a metal.

37. The shaving razor of claim 35, wherein the metal is chromium.

38. The shaving razor of claim 35, wherein the hard carbon containing material is selected from the group consisting of diamond-like carbon and amorphous diamond.

* * * * *

UNITED STATES PATENT AND TRADEMARK OFFICE
CERTIFICATE OF CORRECTION

PATENT NO. : 6,684,513 B1
DATED : February 3, 2004
INVENTOR(S) : Colin Clipstone et al.

Page 1 of 1

It is certified that error appears in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

Title page,

Item [56], **References Cited**, U.S. PATENT DOCUMENTS, please replace "10/1975" and insert -- 11/1975 --

Column 1,

Line 10, delete "-" after "carbon"

Column 2,

Line 2, insert -- , -- after "embodiments"

Column 6,

Line 37, delete "claim 35" and insert -- Claim 36 --

Signed and Sealed this

Ninth Day of November, 2004

A handwritten signature in black ink, reading "Jon W. Dudas". The signature is stylized, with a large, looped initial "J" and a cursive "Dudas".

JON W. DUDAS
Director of the United States Patent and Trademark Office

CERTIFICATE OF SERVICE

I hereby certify that on September 12, 2016, I caused the foregoing to be electronically filed with the Clerk of the Court using CM/ECF, which will send notification of such filing to all registered participants.

I further certify that I caused copies of the foregoing document to be served on September 12, 2016, upon the following in the manner indicated:

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